Forest Health Protection
Pacific Southwest Region

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To: District Ranger, Beckwourth Ranger District, Plumas National Forest

Subject: Review of prescribed fires and tree injury (Report #NE05-6)

At the request of Beth Stewart, Forester, I conducted a field evaluation of two prescribed fires on the Beckwourth Ranger District on July 19, 2005. The objective of my visit was to examine various areas within the prescribed fires to assess fire caused injuries to the conifers, discuss fire salvage marking guidelines and address several resource questions posed by District personnel. Most questions involved some projections regarding the likelihood of bark beetles attacking the fire injured trees and what additional conifer mortality could be expected due to fire injury alone. Beth and I were joined in the field by Mike Davis, Rachel Condon, Alec Lane, Mike McCourt, James Pass and Alissa Tanner.

Site 1. Humbug

This prescribed fire burned in an eastside pine area that was thinned a few years ago to create a defensible fuel profile zone (DFPZ). Archeological sites and riparian habitat conservation areas (RCHA) within the DFPZ were not thinned. We examined a few areas within Stand 46 that were contract burned during June, 2005. Approximately 220 acres were burned in this area. There were some pockets of fire injured trees (higher levels of crown kill) primarily concentrated within the unthinned archeological sites and RHCA's. There was also an unthinned area that was being managed as goshawk habitat that contained some fire caused mortality. Fire injury was variable with some trees being killed outright in the fire, due to complete crown kill, and other trees displaying varying degrees of crown kill. Many pines had various levels of crown scorch but also had new needle growth indicating that the twigs and buds survived the fire. In addition, a quick sampling of a few trees indicated that cambium kill due to either heat or direct burning was none to minimal. A few attacks by red turpentine beetle (RTB), *Dendroctonus valens*, were noted on some of the fire injured pine trees.

Site 2. Hollywood

This prescribed fire also burned in eastside pine stands that had previously been thinned to create a DFPZ. We hiked through several pockets of trees that had varying degrees of crown injury.

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Similar to the Humbug area, there were some trees that were killed outright during the fire due to complete crown kill; this was generally limited to the smaller trees, both in diameter and height. I did not find any trees that sustained a level of cambium injury that would result in additional mortality from that injury alone. Many of the fire injured pines in this burn also had new needle growth extending from the tips of the scorched branches. An increment core of one of the trees indicated a good growth response following the thinning. The increase in health and vigor following the thinning combined with above normal precipitation over the 2004-2005 winter may increase the likelihood of these trees being able to recover from their fire injuries. Attacks by RTB were common on some of the pine trees. Attacks by other *Dendroctonus* sp. beetles such as western pine beetle, *Dendroctonus brevicomis* were not found on any trees.

Discussion

Fire injured trees can be placed into three categories: 1) those killed outright or so severely damaged by the fire that they will soon die; 2) those that are uninjured or lightly injured and should survive, and 3) those in between. Based on my observations in the areas we visited, there are trees that fit into each category. Those in categories 1 and 2 require little additional evaluation. Trees in the third category present the challenge in salvage marking and also provide an opportunity for subsequent attack by bark beetles.

My observations during the field visit indicated very little bark beetle activity with the exception of red turpentine beetle. Some of the fire injured trees may still be attacked by western pine beetle however very little activity is anticipated within the burns. Based on information from other wildfires in California, trees not injured by the fire either within the area of the burn or in the surrounding forest are rarely attacked as a result of a concentration of bark beetle attacks in fire-injured trees. As noted, many of the pine trees had red turpentine beetle attacks, typically less than five attacks per tree at the time of the field visit. Fire injured pine trees with red turpentine beetle attacks have a higher probability of mortality when combined with cambium and/or crown injury (Hood, Smith and Cluck, 2005 draft paper).

Fire injury can be in the form of crown kill or scorch, cambium kill and root kill. Tree mortality can occur from a single type of injury such as crown kill or when injuries are combined, such as cambium kill and crown kill. Early observations (pre-bud break) by District personnel indicated a higher level of anticipated mortality due to what appeared to be complete crown kill on many of the pines. During our visit (post-bud break) we observed bud survival and hence needle elongation on many of those same pine trees. Most of these trees would not meet salvage marking guidelines due to the fact that they have a high percentage of remaining length of live crown. In ponderosa and Jeffrey pines, extensive heat killing of foliage may occur with only light damage to buds and twigs (Wagener 1961). Evaluations of fire injured pines prior to bud break often results in a less accurate determination of the residual live crown.

Based on my examination of the area, it is highly unlikely that the current mortality and any additional mortality will exceed the acceptable level identified in the burn plan. It should also be recognized that the ability to put a prescribed fire through unthinned areas (e.g. RHCA's, archeological sites) and not expect pockets of mortality is unrealistic. Even in thinned areas burned under optimal conditions some mortality occurs and should be anticipated. Depending on

the amount of litter and duff, mortality in larger size trees may also occur due to cambium kill from extended burning around the base of the tree bole. Brush that burns near and around residual conifers can also result in fire injury to trees.

Since the DFPZ's have already been thinned to the desired basal area, it is the intent of the Ranger District to leave all trees that are likely to survive their fire-related injuries. Delaying the salvage of the fire injured trees until next year will allow for a re-assessment of the pine trees that currently have new needle growth. In addition, if some of the trees with minimal residual live crown die, the openings created would not be larger than occurred historically in these stands and the areas will likely seed back naturally over time creating age and structural diversity.

The thinned stands still appeared to be somewhat dense for east side pine and the smaller trees that were left in the stands, particularly the white fir, created fuel ladders allowing the fire to reach the crowns of some of the larger trees. In addition, the residual white firs in these areas are at high risk to fir engraver beetle, *Scolytus ventralis*, attacks. Both the Humbug and Hollywood units are in the 25-30 inch zone for average annual precipitation. In the absence of fire, some of these stands have transitioned to being more heavily dominated by drought intolerant white fir. During periods of protracted drought, the fir engraver beetle can cause mortality that is in excess of acceptable amounts. White fir should be heavily selected against when thinning in stands that receive less than 30" inches of average annual precipitation.

The Standard and Guidelines in the Sierra Nevada Forest Plan Amendment state that land managers will "use the best information available for identifying dead and dying trees for salvage purposes as developed by the Pacific Southwest Region Forest Health Protection Staff (pg. 52 – Record of Decision). If the District would like to move forward with salvaging the fire injured trees, models are available that predict the probability of mortality for individual conifer species based on fire injury criteria and insect activity (Hood, Smith and Cluck 2005). These models can be used to develop salvage marking guidelines depending on 1) the intensity of sampling for fire injuries and insect activity and 2) the desired level of probability of mortality, both determined by the land manager. Fire salvage marking guidelines can be developed by FHP personnel as requested.

I will continuing working with Beth Stewart on any further needs you may have with repect to these prescribed fires. Please feel free to call me at 530-252-6667 or email ssmith@fs.fed.us if you have more questions or need to request additional assistance in the field.

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Red turpentine beetle, *Dendroctonus valens*

The red turpentine beetle normally attacks injured, weakened or dying trees and freshly cut stumps. The adults are attracted by fresh pine resin. The red turpentine beetles are also attracted to trees with fire injuries. A beetle-produced aggregation pheromone is also important in attracting additional beetles into suitable hosts.

Attacks usually occur at the soil line or root crown and are characterized by a large reddish pitch tube at the point of entry. If an attack is successful, the adults excavate an irregular gallery in the cambium and the female lays eggs along the sides. Attacks usually do not kill trees but may predispose them to attack by other bark beetles. Repeated or extensive attacks by the red turpentine beetle can kill pines. Little can be done to control red turpentine beetles once they are beneath the bark. Good health and vigor in a tree and minimizing fire-related injuries are the best protection against infestation. The feeding activity of the adult beetles and their larval offspring kills a limited amount of living tissue. If enough beetles attack a tree so that feeding areas overlap the tree will die as a consequence of the girdling.

Secondary insects

The presence of wood borer frass on the boles, and galleries under the bark, was noted on several of the fire killed trees. There are a number of species of flatheaded (family Buprestidae) and roundheaded borers (family Cerambycidae) that mine in the sapwood, and in some cases, in the heartwood, of dead and dying trees. Attacks initially occur within the first few years after a fire, but can continue for 4 or 5 years, as long as the wood remains sound. The damage to the sapwood and heartwood from these insects, along with fungal deterioration, can be a factor in determining the limit of practical salvage in an area. At this time, wood borers would not be expected to cause any concerns with the trees that survived the fire unless their extent exceeds about 1/3 of the circumference of the bole on individual trees. (see Question 1 below). Their presence may become more important if we experience a dry winter and the fire-injured trees remain stressed.

Insects that bore into the sapwood and cause degradation also include the ambrosia or pinhole borers. The defect caused by this beetle consists of small holes surrounded by a dark stain. Galleries are constructed within the sapwood where the larvae feed on the ambrosia fungus which is introduced by the female beetle as she constructs the galleries. Ambrosia beetles were present in the fire-killed trees as evidenced by piles of fine, white boring dust in the bark crevices.

Wood borers and ambrosia beetles are common in dead trees following wildfires and are important components in decomposition of the wood. Depending upon management objectives, prompt removal of the dead trees will keep the damage to the wood at a minimum.

Specific Questions asked by District Personnel

1. What is the best way to identify insect attacked trees that are likely to die?

Successful attacks on pines are easily identified by reddish-colored pitch tubes on the bole. Pitch tubes that are cream in color are unsuccessful. Pines unaable to produce pitch may only have frass in the bark crevices around the bole. Frass in the bark crevices can also be used as an indicator of insect attack for other conifer species.

2. If snags are retained within or near green clumps, does this put green trees at greater risk for insect attack.

There is no risk involving insects associated with leaving snags under the assumption that a snag is defined as a completely dead tree and therefore would not be viable habitat for bark beetles.

3. Does the species composition of the green trees influence the likelihood of their surviving insect attack? Size of tree? Location?

Most of the bark beetles in California are host specific so species composition plays an important role in stand and bark beetle dynamics. The trees of most concern for bark beetle-related mortality would be the pine species and white fir. Tree size appears to be important for the pine bark beetles. Typically pine trees greater than 8 in. dbh are attacked but attacks have been observed in much smaller trees during protracted drought periods. Fir engraver usually attacks white fir trees greater than 4 in. dbh. Stand conditions in terms of species composition, density, age, size and precipitation appear to be the most important factors involving bark beetle and host interactions.

The incense cedar and hardwood component in this area are not typically associated with insects that would cause tree mortality.

4. Would removing a portion of the standing dead trees reduce the risk of insect attack?

No, there is no risk of bark beetle attack associated with dead trees.

5. What is the best way to limit bark beetle activity in these types of stands?

The best way to reduce future bark beetle-related mortality is to maintain the stand at stocking levels that are appropriate for the site, including diverse species composition, ages and size classes. It is recommended that activities such as thinning or underburning be implemented during periods of relatively low tree stress (i.e. during high precipitation years and prior to stands becoming overstocked). This provides the opportunity for trees to recover quicker from the management activity and doesn't induce additive stresses on the trees. Additive stresses increase the susceptibility of successful bark beetle attack.